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# Using animations of cardiac electrical activity to improve medical students' understanding of cardiac pathology and ECG traces

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## Introduction

Confidence and competence in the interpretation of electrocardiograms (ECGs) is an important skill for medical professionals and students. Recognising pathologies such as a ST-elevation or non-ST elevation myocardial infarction, and arrhythmias including atrial fibrillation, ventricular fibrillation/tachycardia, allow for prompt intervention, improving patient care, especially in the acute setting. While teaching ECG interpretation often begins in the early years of medical school, the majority of learning seems to occur during clinical placements.[1–2] However, current teaching and learning practices often prioritise pattern recognition and the correlation of ECG traces with certain clinical presentations, without having substantial understanding of the underlying cardiac pathology.[1–2] The aim of this study was to support students in gaining confidence in understanding the most common cardiac pathologies and their corresponding ECG patterns, using novel animations in an online lecture.

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## Materials and methods

Digital animations were developed demonstrating electrical activity in a 2-dimensional heart alongside a corresponding ECG rhythm strip for 7 cardiac rhythms (sinus rhythm, atrial flutter, atrial fibrillation, atrioventricular nodal re-entry tachycardia, atrioventricular re-entry tachycardia, right and left bundle branch blocks). These animations were presented to final-year medical students in an online teaching session, hosted on Zoom. Students were invited to participate through social media advertisements,

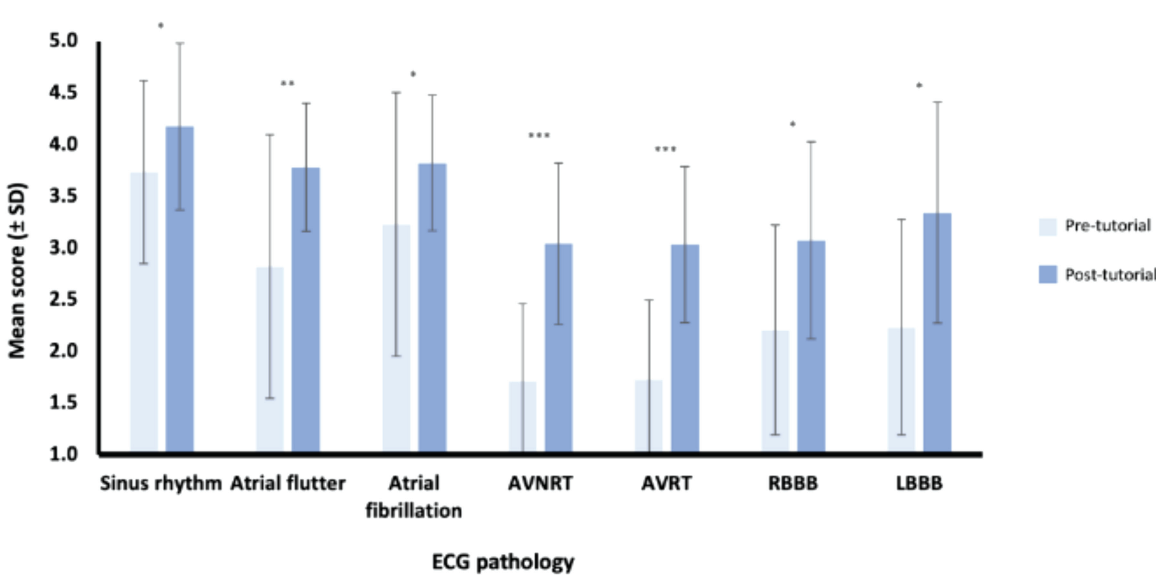


**Fig 1. Confidence reviewing and diagnosing cardiac rhythms and pathology on an ECG (mean score from a 1–5 Likert scale ± standard deviation); n = 15; paired T-test results: *p<0.05; **p<0.01; ***p<0.001.**

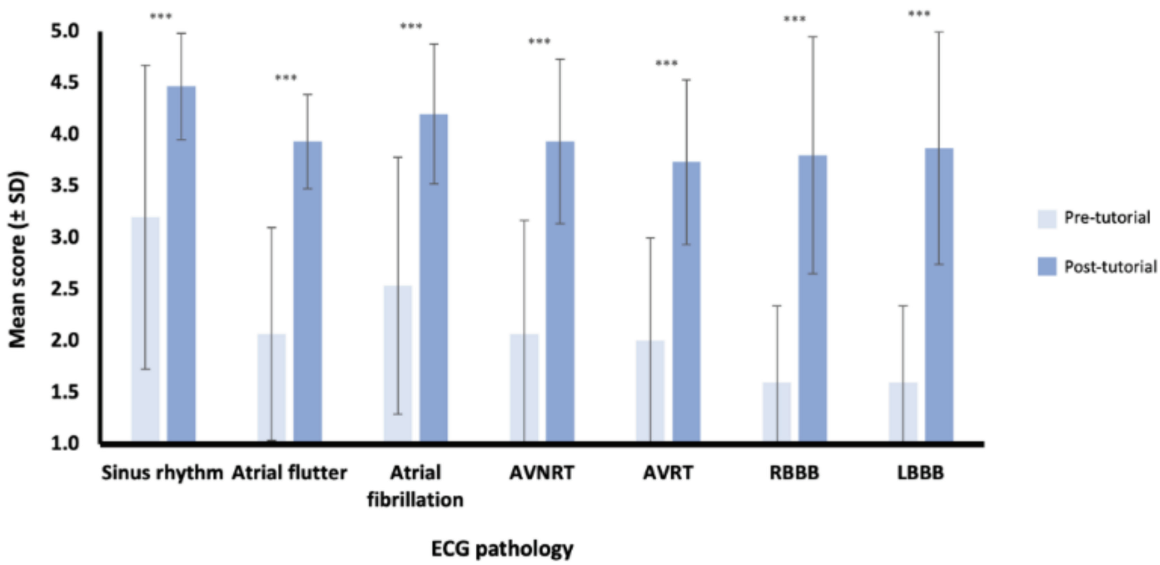


**Fig 2. Confidence visualising electrical activity through the heart in different ECG pathologies (mean score from a 1–5 Likert scale ± standard deviation); n- = 15; paired T-test results *p<0.05; **p<0.01; ***p<0.001.**

with spaces limited to the first 20 students who signed up. Participants were invited to complete a questionnaire before and at the end of the session, assessing confidence in reviewing cardiac rhythms and visualising electrical activity for each of the animated cardiac pathologies through 5-point Likert scale questions. Students were also invited to a focus group following the session, to explore their experience of the animations in greater depth. Questionnaire data was summarised descriptively using two-tailed, paired T-tests to check for statistical significance on Excel, and focus group transcripts were analysed using inductive thematic analysis on NVivo.

## Results and discussion

Of all students who signed-up for the tutorial, 15 (75%) completed the pre- and post-session questionnaires. Statistically significant improvements ($p<0.05$) were seen across all pathologies demonstrated for both reviewing of ECGs and visualisation of cardiac electrical activity (Figs 1–2). Three key themes arose from the focus group discussions: past ECG learning has focused on clinical context and memorisation of traces, (but with limited understanding of cardiac electrical activity), the animations enabled a deeper understanding of the electrical activity in cardiac pathology, and animations are most useful when used alongside clinical contextualisation. Students suggested that other revision tools, including clinical vignettes or interactive single-best answer questions, as well as the lecture slides should be provided to be reviewed by students independently, with the ability to control the animation speed and check their answers.[3–4]

## Conclusion

Digital animations of cardiac electrical activity presented alongside ECG traces improved medical students' confidence in interpreting ECGs. This low-cost intervention is likely to be most valuable when presented alongside clinical vignettes in which discussions regarding investigations and management options can be made. Interactivity within teaching sessions using quizzes and spaced practice is also recommended, allowing students to access the resources to help consolidate their learning.[3–5] ■

## References

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